

NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FOREST STAND IMPROVEMENT (ACRE)

CODE 666

DEFINITION

The manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation.

PURPOSES

- To increase the quantity and quality of forest products, e.g., sawtimber, veneer, wood fiber, poles, pilings, maple syrup, naval stores, nuts, and fruits.
- To harvest forest products.
- To initiate forest stand regeneration.
- To reduce the potential damage from wildfire, pests, diseases, and moisture stress.
- To improve forest health, stand condition and species diversity.
- To restore natural plant communities.
- To achieve a desired understory plant community.
- To improve aesthetic, recreation, and open space values.
- To improve wildlife habitat.
- To improve water conservation and yield.
- To achieve a desired level of crop tree stocking and density for best growth.
- To increase carbon storage in selected crop trees.

- To improve forage production on grazable woodland.

CONDITIONS WHERE PRACTICE APPLIES

- All forestland where improvement of forest resources is needed.
- Where a stand of trees is overstocked or where less desirable trees and shrubs overtop desirable trees.
- Where removing part of a stand will improve growth and quality of forest products, forage production, or the recreation, wildlife, aesthetic or hydrologic values of an area.

CRITERIA

General Criteria Applicable to All Purposes

Priority should be given to high quality sites.

Preferred tree and understory species are identified and retained to achieve all planned purposes. Leave only good quality trees of the species desired that have full crowns, good form, are vigorous and have a good chance of developing into a merchantable product or meeting other resource objectives. Remove all crooked, dying, diseased, injured and suppressed trees, when selecting which trees should be cut. In mixed stands, select against species that are slower growing.

Take precautions to prevent invasion and spread of weeds, insects and disease, and to reduce fire hazards from slash and other dead wood.

NRCS, MT
August 2001

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard contact the Natural Resources Conservation Service.

NOTE: This type of font (**AaBbCcDdEe 123..**) indicates NRCS National Standards.
This type of font (**AaBbCcDdEe 123..**) indicates Montana Supplement.

Slash and debris left on the site after treatment will not present an unacceptable fire, safety, environmental, or pest hazard. **Comply with Montana's Hazard Reduction Act (slash).** Such remaining material will not interfere with the intended purpose or other management activities.

Stocking guidelines shall contain stocking in terms of basal area, spacing or trees per acre by species and size class distribution.

Stocking guidelines by species:

Use the D+X spacing in even-aged stands. Use Basal Area in uneven-aged stand. Refer to the National Forestry Handbook, Part 636.2 for proper inventory methods.

D+X is defined as: Average stand diameter (D) after treatment plus a constant (X).

EX. If D = 9" and X = 6, then average spacing is 9+6, or 15 feet. Stocking at 15'x15'=194 trees/ac.

Ponderosa pine

Even-aged:	D+ 6 to 10*
Uneven-aged:	63 – 84 ft²/ac*

Douglas-fir, Spruce, Fir, Cedar, Hemlock

Even-aged:	D+ 7 to 9*
Uneven-aged:	65 – 88 ft²/ac*

Western larch

Even-aged:	D+ 8 to 10*
Uneven-aged:	56 – 75 ft²/ac*

Lodgepole pine

Even-aged:	D+ 5 to 7*
Uneven-aged:	78 - 110 ft²/ac*

* Use the *upper* stocking levels in healthy stands on more productive sites where understory production (grass, shrub, and tree seedlings) is not a concern.

Use the *lower* stocking levels on less productive sites, to encourage growth of established tree seedlings, to improve forage production on grazable forests, to reduce fire hazards, or where lower levels are necessary when removing undesirable species or infected trees.

Do not exceed desired stocking levels by +/-25%.

Stocking may exceed the upper limit if thinning a very dense stand would result in losses due to bending or windthrow. Lower limits could be exceeded if needed to remove unhealthy or poorly formed trees.

EXAMPLE: If the desired stocking in an even-aged stand calls for 136 trees/acre, do not go below 102 or above 170 trees/acre, +/- 36 trees/acre. Likewise, in an uneven-aged stand where the desired stocking is 72 ft²/ac, do not go below 54 ft²/ac or above 90 ft²/ac, +/- 18 ft².

Forest Stand Improvement—Thinning

The primary objective of thinning is to improve growth and quality of remaining trees with minimum disturbance to the site. Regeneration is not an objective. Wood products may or may not result.

1. **Commercial Thinning** – reducing forest stocking by harvesting a portion of the merchantable trees in a stand. This may include some non-merchantable trees in the thinning operation.
2. **Pre-Commercial Thinning** - reducing forest stocking in immature stands by removing a portion of the non-merchantable trees in a stand.

Species most suitable for pre-commercial thinning in order of priority are:

- Lodgepole pine, 15 to 30 years old
- Ponderosa pine
- Western larch
- Douglas-fir

Young sapling and pole size stands respond better to thinning. Lodgepole pine stands should only be thinned between the ages of 15 and 30 years old since older stands do not respond well.

Where usable or salable specialty products (logs, post, poles, or Christmas trees) are to be cut, they will be removed in a manner that will maintain or improve the stand.

Use one or a combination of the following thinning methods :

1. **Mechanical** – Unwanted trees in a stand are removed by the use of a chainsaw, brush saw, feller-buncher, axes, loppers, or any other mechanical device. Cut the tree just below the lowest live limb or six inches above the ground (12 inches for commercial harvests) which ever is closest.
2. **Chemical** – Unwanted trees in a stand are removed by the use of a backpack pump sprayer. Use an appropriate, registered herbicide for the species being removed. Permit no chemicals to enter any waters and leave a buffer strip around any water or intermittent streams. Follow label instructions.

To avoid damage from bark beetles do not thin ponderosa pine and lodgepole pine stands between April 1 and September 30 unless slash is to be removed from the site, chipped, or burned before spring.

Forest Stand Improvement—Harvesting

The primary objective of harvesting is to remove wood products with a minimum disturbance to the site and to provide for regeneration of a new stand or perpetuation of the existing forest.

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting:

- Even-aged management (clear-cut, seed-tree, shelterwood, and coppice) refers to stands having – or planned to have - only one age class, i.e. trees within a 20-year age span.
- Uneven-aged management systems (single-tree selection, group selection, and coppice selection) refer to stands having—or planned to have—several age classes.
- Successful regeneration of a new stand is defined as 250 seedlings per acre at least 5 years old. Both natural and artificial regeneration may be needed to meet this goal or if a change of species is desired.
- **Even-aged Management Harvest Systems:**
 1. **Clearcut**—All trees regardless of age or size are cut. This system is applicable to mature or over mature and decadent stands where natural or artificial regeneration of shade

intolerant species is desired. These can be in patches or strips and should be at least an acre in size. Often clear-cuts are configured to fit the natural shape, size and spacing of stands. This variability can also be recreated within large uniform stands for aesthetic reasons if desired. The shade intolerant species best suited to this system are lodgepole pine, ponderosa pine, western larch, western white pine and Douglas-fir. Some ground disturbance is desired for seedling establishment.

2. **Seed Tree**—This system is similar to a clearcut with the following difference. The cutting unit is too large for adequate dispersal of seed from the edges or a change of species is desired. Leave about 10 large trees per acre of the desirable species capable of producing seed. Remove all others. Seed trees should be wind firm, healthy and well distributed over the area. Since trees do not bear abundant seed every year the regeneration process may require 6 to 10 years. Species best suited for this type of system are ponderosa pine, western larch, white pine, and Douglas-fir. Some ground disturbance is desired for seedling establishment. After establishment the seed trees may be removed.
3. **Shelterwood**—This system is best suited to natural regeneration of species with some shade tolerance. Shelterwood has some advantages such as retarding growth by shading unwanted brush, better reproduction on harsh sites, aesthetically pleasing, and less wind throw hazard.

Trees are removed in a series of cuts. Remove trees leaving about 40 large trees per acre of the best desirable species capable of producing seed. Remove all other undesirable species that may be a source of seed. Seed trees should be wind firm, healthy and should be well distributed over the area. After adequate regeneration is achieved, the remaining older stand is removed. Initiate un-even aged stand development, if desired, by harvesting only a portion of the overstory. Species best suited for this type of system are ponderosa pine, western larch, and Douglas-fir. Some ground disturbance is desired for seedling establishment.

4. **Coppice**—Produces stands originating from vegetative sprouting following harvest. They may be in the form of stump sprouts or root suckers. Coppicing usually involves short rotations with dense stands of trees capable of suckering or sprouting. In even-aged management, patches of trees are cleared to allow for the stand to regenerate. Species best suited for this type of system are quaking aspen and cottonwoods.

3. **Coppice selection**—Involves the removal of individual trees from a stand which stimulates vegetative sprouting or suckering of new shoots. Requires species capable of suckering or sprouting. The species best suited to sprouting from a partial removal of the overstory are cottonwoods.

- **Uneven-aged Management Harvest Systems:**

1. **Single-tree selection**—Involves the removal of individually selected trees from a stand. A succession of different age groups is present ranging from seedlings to sawlogs. Harvest individual mature trees from each age class. Also thin seedlings and saplings pre-commercially following the harvest. Follow basal area stocking guidelines described earlier. Remove poor condition, diseased, and any undesirable species that are interfering with the growth and development of the remaining stand. The process reopens the stand and provides more growing space to the remaining trees, as they grow larger. The shade tolerant species best suited for this type of system are Engelmann and white spruce, grand and subalpine firs, and western redcedar.
2. **Group selection**—Involves the removal of groups of trees from a stand to create small openings. The purpose is to regenerate different age groups of the desired species. The size of the openings is dependent upon the availability and location of the seed source. Openings can be 1/4 to 1 acre in size but should not exceed 5 acres. Species best suited for this type of system are Douglas-fir, western hemlock, western white pine and western larch, and lodgepole pine. Some ground disturbance is desired for seedling establishment.

Where natural or artificial regeneration is intended, the method and degree of scarification during harvest will be described. Refer to Field Office Technical Guide (FOTG), Section IV, Practice Standard 490—Forest Site Preparation for more detailed information and guidance regarding this practice.

The extent or size of treatment area shall achieve the intended purpose.

Spacing, density, size class, number, and amounts of trees and understory species to be retained will follow established guidelines for the intended purposes.

The method, felling direction and timing of tree cutting for harvesting shall facilitate efficient and safe tree removal and protect sensitive areas such as vernal pools, riparian zones, cultural resources, and structures. **Mark unit boundaries and sensitive areas well before hand so they can be easily identified throughout improvement activities.**

Use the logging system and equipment appropriate for the site. Refer to FOTG, Section IV, Practice Standards, 655—Forest Harvest Trails and Landings for more detailed information and guidance regarding this practice.

Forest stand improvement activities shall be performed to minimize soil erosion, compaction, rutting, and damage to remaining vegetation and hydrologic conditions. **Refer to forest management soils interpretations for guidance. Avoid wet soil conditions. If unavoidable, harvest on frozen ground or when there is at least 12 inches of snow cover.**

Comply with applicable federal, state and local laws and regulations during the installation, operation and maintenance of this practice. **Comply with Montana's voluntary forestry Best Management Practices (BMP) and Streamside Management Zone (SMZ) laws.**

CONSIDERATIONS

Use the attached Forest Practice Decision Matrix to help determine the appropriate forest stand improvement treatments.

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

Consider some of the following factors when deciding on a silvicultural system:

- Desires of the landowner
- Characteristics of the existing stand—age, size, species, presence of insects and disease
- Type of soil and slope
- Products to be harvested—availability of markets
- The economics of the operation

Successful regeneration of desirable species is usually dependent upon timely application of forest stand improvement and other practices, e.g., prescribed burning, site preparation, tree and shrub establishment, prescribed grazing and use exclusion.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted to minimize cumulative effects (onsite and offsite), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity and visual resources.

Potential landowner and operator liability should be assessed before forest stand improvement activities begin.

Consider pruning while thinning. The primary objective of pruning is to produce sawlogs with clear wood. Other objectives include reducing fire hazards, improving access through a stand, and increasing the amount of sunlight to the understory. Refer to FOTG, Section IV, Practice Standard 660—Tree/Shrub Pruning for more detailed information and guidance regarding this practice.

Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, responsibilities of each party and amount and timing of payments for services provided.

Wildlife

The practice should be timed to minimize disturbance of seasonal wildlife activities.

Consider retention of selected dead and dying trees, including down material, to enhance wildlife habitat values.

Consider wildlife food and cover needs when making modifications to forest composition and tree spacing. Uneven-aged stands attract a wider variety of wildlife than even-aged stands. However, wildlife habitat needs to be evaluated on a landscape level. Use the Wildlife Habitat Appraisal Guide (WHAG) for forest wildlife species to determine habitat needs.

Consider environmental concerns such as threatened and endangered species and natural areas. The Canadian lynx is a threatened and endangered species in Montana. The snowshoe hare is the primary food source of the lynx. Consider leaving small brush or slash piles for snowshoe hare habitat and cover. In lodgepole pine stands consider leaving small unthinned pockets of seedlings and saplings for snowshoe hare food.

PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Periodic inspections during treatment activities are necessary to ensure that objectives are achieved and resource damage is minimized.

A stocking survey should be performed following thinning to make sure that desired stocking rates are achieved. In most cases acceptable stocking rates are plus or minus 25 percent of the desired rate.

Maintain marking of sensitive areas and monitor equipment exclusion throughout harvesting operations.

Follow-up and ongoing management activities will be needed to obtain desired results.

Monitor stands for insect and disease outbreaks or new weed infestations. Monitor natural regeneration, planted seedling survival and effectiveness of site scarification.

666-6

NO INFORMATION

NATURAL RESOURCES CONSERVATION SERVICE

FOREST STAND IMPROVEMENT—HARVESTING (ACRE)

CODE 666A

MONTANA CONSERVATION PRACTICE SPECIFICATION / JOB SHEET

LANDOWNER

FIELDS

ACRES

LEGAL LOCATION: _____

DEFINITION AND PURPOSE: Systematically removing some or all of the merchantable trees from a forest stand to improve the conditions for forest growth and/or to encourage regeneration and normal development of a new stand.

STAND DESCRIPTION

	<u>BEFORE HARVESTING</u>	<u>AFTER HARVESTING</u>
Age Class (YRS)	_____	_____
Composition (%)	_____	_____
Size (DBH)	_____	_____
Condition (G F P)	_____	_____
Other: _____	_____	_____

SOILS

Soil(s): _____

Limitations Ratings:	Equipment _____	Seedling Mortality _____
	Windthrow _____	Plant Competition _____
	Other: _____	

Soil(s): _____

Limitations Ratings:	Equipment _____	Seedling Mortality _____
	Windthrow _____	Plant Competition _____
	Other: _____	

HARVEST METHOD

EVEN-AGED MANAGEMENT HARVEST SYSTEMS:

- | | |
|--------------------------------------|--|
| <input type="checkbox"/> Clearcut | <input type="checkbox"/> Thinning |
| <input type="checkbox"/> Shelterwood | <input type="checkbox"/> Coppice |
| <input type="checkbox"/> Seed-Tree | <input type="checkbox"/> Overstory Removal |

UNEVEN-AGED MANAGEMENT HARVEST SYSTEMS:

- | |
|--|
| <input type="checkbox"/> Group Selection |
| <input type="checkbox"/> Coppice Selection |
| <input type="checkbox"/> Single-Tree Selection |
| <input type="checkbox"/> Thinning |

Wood Products: _____

Trees to Leave/Cut, Spacing, Equipment, Season, etc: _____

Specification MT666A-2

SITE PREPARATION

Desired Species to Regenerate: _____

Site Preparation: _____ AS PART OF HARVEST _____ SEPARATE OPERATION

_____ See FOTG, Section IV, Practice Standard 490–Forest Site Preparation

_____ See FOTG, Section IV, Practice Standard 612–Tree and Shrub Establishment

SLASH DISPOSAL

Describe Method, Timing: _____

ADDITIONAL NOTES

ATTACHED SPECIFICATIONS

338–Prescribed Burning	<input type="checkbox"/> YES	<input type="checkbox"/> NO
342–Critical Area Planting	<input type="checkbox"/> YES	<input type="checkbox"/> NO
490–Forest Site Preparation	<input type="checkbox"/> YES	<input type="checkbox"/> NO
560–Access Road	<input type="checkbox"/> YES	<input type="checkbox"/> NO
612–Tree/Shrub Establishment	<input type="checkbox"/> YES	<input type="checkbox"/> NO
655–Harvest Trails & Landings	<input type="checkbox"/> YES	<input type="checkbox"/> NO
666B–Pre-Commercial Thinning	<input type="checkbox"/> YES	<input type="checkbox"/> NO
_____	<input type="checkbox"/> YES	<input type="checkbox"/> NO

APPROVALS:

NRCS Conservationist

Job Class

Date

Producer

Date

INSTALLATION CHECK:

NRCS Conservationist

Date

NATURAL RESOURCES CONSERVATION SERVICE

FOREST STAND IMPROVEMENT—PRECOMMERCIAL THINNING

(ACRE)

CODE 666B**MONTANA CONSERVATION PRACTICE SPECIFICATION / JOB SHEET**

LANDOWNER

FIELDS

ACRES

LEGAL LOCATION: _____

DEFINITION AND PURPOSE: Removing unmerchantable or unwanted trees from forested areas to fully use a site's potential; to maintain plant cover; to improve stand composition by leaving the best trees—spaced for best growth; to improve forage production; or improve natural beauty, wildlife, or recreation values.

OBJECTIVES

- ☐ Reduce Stocking ☐ Change Composition ☐ Improve Condition
☐ Reduce Health Problems ☐ Other: _____

STAND DESCRIPTION**BEFORE THINNING****AFTER THINNING**

Stocking: (# / AC.) _____

Composition: (%) _____

Average Age(s) (YRS.) _____

Average Diameter (IN.) _____

Insects & Disease _____

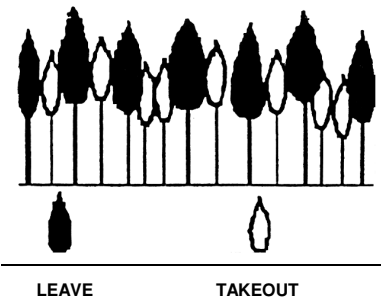
THINNING SPECIFICATIONSDesired Spacing: _____ trees/ acre \pm 25%

APPROXIMATELY _____ ft X _____ ft

Trees to Leave/Remove: LEAVE ONLY GOOD QUALITY TREES OF
 _____ THAT HAVE FULL CROWNS, GOOD FORM
 AND GROWING VIGOROUSLY. REMOVE ALL CROOKED, DYING,
 DISEASED, INJURED, AND SUPPRESSED TREES.

Dates to be Performed: _____

Type of Equipment: _____

**SLASH DISPOSAL**

- ☐ Interior Treatment Area ☐ Property Boundary—100-foot swath
 _____ Pile & Burn _____ Pile & Burn
 _____ Lop & Scatter _____ INCHES SLASH HEIGHT _____ Lop & Scatter _____ INCHES SLASH HEIGHT

Specification MT666B-2

JOB SKETCH

Attached Plan Map

☐

YES

☐

NO

ATTACHED SPECIFICATIONS

338–Prescribed Burning

☐

YES

☐

NO

528A–Prescribed Grazing

☐

YES

☐

NO

☐

YES

☐

NO

ADDITIONAL NOTES

APPROVALS:

NRCS Conservationist

Job Class

Date

Producer

Date

INSTALLATION CHECK:

NRCS Conservationist

Date

FOREST PRACTICE DECISION KEY

- STEP 1:** Determine land management objectives—i.e., wood production, forage production, wildlife habitat enhancement, esthetics, etc. The more detailed the objectives are—the better.
- STEP 2:** Inventory the stand.
- STEP 3:** Define the desired future condition of the stand in light of the objectives and inventory.
- STEP 4:** Select the appropriate practices using the DECISION KEY below.

NOTE: The key is not an exhaustive list of things to consider. For example, tree form (a consideration for cutting sawlogs) is not. Also, depending on objectives, it may be desirable to have trees in unhealthy conditions to attract wildlife.

- 1a. Desirable species are growing at their potential or are able to release given adequate growing space2
- 1b. Desirable species are not able to release given adequate growing space REPLACE EXISTING STAND
- 2a. Desirable species are healthy3
- 2b. Desirable species are not healthy REPLACE EXISTING STAND
- 3a. Stand is overstocked (according to objectives) with desirable species..... MANAGE EXISTING STAND
- 3b. Stand is fully stocked (according to objectives) and4
- 3c. Stand is understocked (according to objectives) with desirable species5
- 4a. Undesirable species are overabundant (desirable species understocked)5
- 4b. Undesirable species absent or not significant NO TREATMENT NEEDED
- 5a. Stocking level of desirable species is adequate to help meet objectives MANAGE EXISTING STAND
- 5b. Stocking level of desirable species is too low to help meet objectives REPLACE EXISTING STAND

REPLACE EXISTING STAND

- Clear-cut
- Seed tree cut
- Shelterwood cut
- Selection (single tree or group) <DEFINE ALL TREATMENTS NOT DESCRIBED IN STANDARDS>
- Sanitation/salvage cutting
- Planting or natural regeneration

MANAGE EXISTING STAND

- Thinning (commercial, pre-commercial)
- Improvement cut
- Sanitation/salvage
- Over/understory

Specification MT666A/B-2

FOREST PRACTICE DECISION KEY continued

DEFINITIONS:

<u>Fully Stocked:</u>	According to the Field Office Technical Guide, Section III—Quality Criteria: Recommended D + X plus or minus 25%. Example: The recommended spacing for a low-site Douglas-fir stand is D + 8. If average stand diameter is 10 inches, this translates into and 18 feet spacing or 135 trees per acre plus or minus 34 (25%). Outside of this range is considered over or under stocked.
<u>Desirable Species:</u>	The tree species suited to the management objective of the landowner. Example: A mixed forest of conifers and hardwoods. For wood production, the hardwoods may be undesirable; but for wildlife habitat, both may be desirable.
<u>Stand Health:</u>	Stands with infestations of insects or disease, have reached old age, or have been suppressed for long periods, are poor health risks. Also included are stands with excessive amounts of dead material (branches, standing snags or downed logs) that pose a high fire hazard.
<u>Release:</u>	The ability of trees to take advantage of additional sunlight, moisture, and nutrients and increase their rate of growth when surrounding trees are removed.
<u>Salvage cutting:</u>	The harvest of dead, dying, damaged or deteriorating trees primarily to put the wood to use before it becomes worthless.
<u>Sanitation cutting:</u>	The harvest of dead, dying, damaged or deteriorating trees as well as those susceptible to attack, but for the purpose of reducing the spread of biotic pests.
<u>Improvement cutting:</u>	Partial or complete removal of any undesirable tree species in a mixed stand due to potential forest health problems, low productivity or marketability, or other management objectives.
<u>Overstory removal:</u>	Cutting the remaining overstory left from a prior harvest after regeneration has been established; or removal of decadent or undesirable trees to release the understory stand.
<u>Understory removal:</u>	Similar to improvement cut but restricted to understory species. This is common where regeneration following harvest is of an undesirable species.